Insect and Pathogen Assessment
for the
Cedar Gulch Area
Cabinet RD, Kootenai NF

INTRODUCTION

In assessing the insects and pathogens in this analysis area, we decided to use an analysis method being developed for Region One by the Forest Health Protection Unit (FHP). In 1991, FHP undertook an analysis to identify and characterize important successional functions of forest pathogens and insects in Montana and northern Idaho. These efforts are aimed at describing how pathogens and insects affect spatial and temporal patterns of succession. Only those pathogens and insects which have significant successional functions at a Regional scale were analyzed. For each of these agents the actions and the functions have been defined. The "actions" on the part of the pathogen or insect, in conjunction with the physical conditions of the polygons (stands), determine the most likely functions of the pathogen or insect. These include the potential vegetation type, cover type, structural stage, elevation, and so on. When applying this analysis system to other spatial scales, it may be necessary to add other pathogen or insect functions to the analysis and leave out others to better reflect local conditions.

CURRENT CONDITIONS

Array Table

Action Probability Indices (APIs) are probabilities that an agent will cause a transition in forest type and/or successional stage. Using methods from the aforementioned analysis, action probability indices were calculated for each Regionally significant agent (pathogen/insect) and placed in an array table. This table also includes other stand information such as structural stage, habitat type, forest type, etc. This array table is included as an appendix for reference. Also, cross-tabulations of the frequencies of these APIs by habitat group are included as another appendix. Numbers from the array table and cross-tabulation tables may be referred to throughout this assessment.

Agents in the Analysis Area

Six groups of agents are represented in the array table. These are root disease, white pine blister rust, dwarf mistletoes, bark beetles, western spruce budworm, and stem decays. I'll address the minor agents first, then the more significant agents.

White pine blister rust APIs (WPBR CrPr) are zero except for 5 stands. These 5 stands have ratings from 1 to 5. A rating of 5 is considered moderate and may affect succession. White pine blister rust is present in the analysis area, but its affect on succession is likely to be minimal. This is due to the amount of western whitepine present in individual stands (<50%) and the larger size of the individual trees (most are >12" dbh). These trees are more likely to survive for an extended period of time after infection. If younger western white pine stands were present in the analysis area, they would receive higher

WPBR APIs and the disease would be expected to greatly affect succession in those areas.

Western spruce budworm "hazard" (WSBW Haz) is relatively high for a few stands, but the Kootenai NF as a whole has a limited pattern (WSBW Pt). This means that historical and expected future WSBW activity are very infrequent and seldom damaging on the Forest.

APIs for mountain pine beetle in lodgepole pine are generally low, but 3 stands have moderate to high APIs (MPB LP). Lodgepole pine is considered a minor seral species in these moderate to high API stands, so mountain pine beetle will likely have no overall affect on succession.

According to the stand data collected, Douglas-fir and western larch dwarf mistletoes can be found on approximately 23% of the surveyed acres in the analysis area. The calculated mistletoe APIs indicate mistletoes are expected to have little overall affect on succession across the analysis area. Although little affect is expected on succession, mistletoe infected stands are known to have significantly reduced volume growth due to this disease. Specific growth and yield information is not available for this area, but an insect and disease impact survey done in 1978 indicates average growth losses from western larch and Douglas-fir dwarf mistletoes of 20 cubic feet/acre/year for each mistletoe across the Kootenai National Forest.

The three groups of agents with consistently high APIs in this area and thus a high probability of affecting succession are bark beetles, stem decays, and root diseases. These agents are found in the array table columns as DFB Grp Prb (Douglas-fir beetle, group probability), MPB WP (mountain pine beetle in western white pine), Stm Dcy ET (stem decay, Echinodontium tinctorium), and RR SV (root disease severity). Root disease appears to be the most prevalent agent, and is the most significant with regards to affecting succession.

The probability of Douglas-fir bark beetles killing groups of trees is high on 95 acres (out of a total of 4500+ acres) and moderate on 59 acres. All these acres are in the grand fir or western hemlock habitat series. The overall effect of Douglas-fir beetle acting in this area would be to reset succession to an earlier stage, which would occur if the beetle-killed groups are large enough to allow the regeneration of Douglas-fir; or to push the stand towards climax by eliminating the big Douglas-fir and allowing the stand to convert more quickly to grand fir or western hemlock.

The probability of mountain pine beetle (MPB) in western white pine (WP) is high on 137 acres and moderate on 327 acres. In the stand with a moderate API and also having a WP cover type (only one stand in this analysis area), the probable effect of MPB would be to eliminate western white pine from the stand, or reduce the WP component enough to change the cover type, which would push the stand towards the climax species (mountain hemlock) faster. In the stands with the high and moderate, but having a non-WP cover type, the role of MPB would be to eliminate large WP as a stand component but not necessarily cause a transition to a different cover type, but possibly causing a transition from a structural stage 2 or 3, to a structural stage 4.

The probability of Echinodontium tinctorium (Et) is high (API=10 or 11) on only 21 acres, but is moderate (API=5 to 9) on almost 500 acres. The effect of Et

on succession is more subtle than the other agents aforementioned. On the acres with a high API, Et can cause a transition in cover type as the susceptible species is slowly eliminated from the canopy by periodic stem failures, or it can change quickly if a wind storm comes through and snaps out many of the infected stems at one time. The most pervasive effect of Et in this analysis area is the high probability of changing the structural stage from a 3 (closed canopy and well stocked) to a 4 (a broken up canopy and moderately to poorly stocked), and maintaining structural stage 4 where it presently occurs. This is also the case for the stands with a moderate API for Et, but to a lesser degree.

Root disease is by far the most significant agent acting in this whole analysis area. A high root disease severity rating has been given to 441 acres; a moderate severity rating to 304 acres; and a low severity rating to 1084 acres. The western hemlock habitat series has the highest average severity rating (5.8). Western redcedar habitat series have an average severity rating of 4.8; grand fir, Douglas-fir, mountain hemlock, and subalpine fir habitat series all range from 1.4 to 2.3.

Douglas-fir is the most root disease susceptible species in Region One. The most recent statistical analysis of root disease permanent plots shows a great variation in mortality rates for Douglas-fir. Some plots experience rates up to 30% by volume per year. Ten-year analysis of permanent plots in north Idaho (Fernan RD, IPNF) indicate mortality rates are closely tied to the root disease severity level. Douglas-fir mortality rates on plots with low severity (1,2,3) are 2.8% (by volume/year), at moderate severity (4,5,6) the mortality jumps to 6%, and at high severity (7,8,9) the rate drops to 3%. These rates are across all habitat types. When these values are applied across the analysis area, a mortality rate (by volume) for Douglas-fir of 3.4% per year can be expected.

The successional regimes for root disease-influenced forests must be considered across several generations of trees in order to account for the slow changes in the fungi themselves. Succession and root disease behavior are strongly correlated with habitat types. On western hemlock habitat types, which occupy almost 50% of the analysis area, an almost continuous distribution of root pathogen colonies can be expected. Douglas-fir has been measured to significantly reduce in importance in stands on these sites by age 40 due to root disease-caused mortality. Grand fir is also usually killed at a fast rate likely due to high fungal biomass on these sites. Western white pine is a very significant seral species on these sites, and its prolonged presence was common prior to the introduction of white pine blister rust. Root pathogen biomass would likely decrease considerably under a white pine cover and would be expected to allow occasional development of a grand fir stand. Fire suppression and the absence of a western white pine seed source would eventually lead to decline of grand fir and replacement with western hemlock. Although western hemlock is considered somewhat tolerant to root pathogens, it does succumb to them on sites with high root disease biomass. Large root disease patches can and do occur in these habitat types.

FUTURE CONDITIONS

Forest Vegetation Simulator (FVS) Projections
The FVS was utilized to demonstrate the transitions and growth losses to be expected from insects and diseases in this analysis area. Due to time

constraints, only 9 stands were run through FVS, but these 9 stands are of varying habitat types and root disease severity. Projections over 100 years were done with and without the Root Disease Pest Extension. The Root Disease Pest Extension is presently being calibrated using actual transitions that have occurred in Region One. Unfortunately, calibration has not been done for the western hemlock habitat types, which make up almost 50% of the analysis area. The runs that were done include stands in cedar, mountain hemlock, grand fir and Douglas-fir habitat types. If it would be helpful, I would be happy to do more runs in the future after the model has been calibrated for the western hemlock series.

A summary table of the FVS runs has been included as an appendix. I will illustrate the transitions that occurred due to insects and diseases for a few of the projections, and how volume was affected by comparing runs with the Root Disease Pest Extension and runs without the Pest Extension. Two stands in the western redcedar habitat series with high root disease severity (71106020 and 71106007), projected out 100 years with the Pest Extension, revealed a transition from Douglas-fir forest type, structural stage 3 to a cedar forest type, structural stage 4. Without the Pest Extension, the stands remained Douglas-fir, structural stage 3. The total cubic foot volume after 10 cycles with the Pest Extension was about 10% of the volume after 10 cycles without the Pest Extension. In this case, root disease was pushing the stands into climax faster, and the stands were losing Douglas-fir volume throughout the projection with the Pest Extension.

One stand in the mountain hemlock series with low root disease severity (71106045), projected out 100 years with and without the Pest Extension showed no variation in transitions. Both projections transitioned from a western larch forest type, structural stage 2, to a western larch forest type, structural stage 3. The difference between the two projections is apparent in the volume growth over the projection. The total cubic foot volume after 10 cycles with the Pest Extension was about 63% of the volume after 10 cycles without the Pest Extension. The volume difference is due to mortality from root disease, Douglas-fir bark beetles, and other more minor agents.

One stand in the grand fir series with moderate root disease severity (71106048), projected out 100 years with the Pest Extension, transitioned from Douglas-fir forest type, structural stage 2, to ponderosa pine forest type, structural stage 4. In this case, root disease was weeding out the Douglas-fir and pushing the stand into a ponderosa pine seral stage. If this stand was projected out longer, root disease would continue to favor the ponderosa pine seral over the Douglas-fir, and the stand would likely transition into a ponderosa pine forest type, structural stage 3. The 100 year projection without the Pest Extension revealed a transition from Douglas-fir forest type, structural stage 2, to a Douglas-fir forest type, structural stage 3. The total cubic foot volume after 10 cycles without the Pest Extension was twelve times more than the end volume with the Pest Extension. Again, this volume difference is largely due to mortality and growth losses from root disease and bark beetles.

One last example is a stand in the Douglas-fir habitat series with moderate root disease severity (71106016). A 100 year projection with the Pest Extension revealed a transition from Douglas-fir forest type, structural stage 2, to Douglas-fir forest type, structural stage 4. Without the Pest Extension,

the stand transitioned to Douglas-fir forest type, structural stage 3. If this stand was projected out farther with the Pest Extension, it might transition to Douglas-fir, structural stage 1, and early stage in stand development, or to ponderosa pine, various structural stages. The difference would depend on the amount of ponderosa pine present in the stand. The total cubic foot volume after 10 cycles with the Pest Extension was only 14% of the volume after 10 cycles without the Pest Extension. Again, the differences between these 2 projections is largely due to mortality and growth losses from root disease and bark beetles.

SUMMARY

In summary, root disease is the most significant agent present in the analysis area. If no management actions are employed in the area, which is represented by the FVS runs with the Pest Extension, overall mortality rates can be expected to be high. Management actions that would decrease Douglas-fir and other root disease susceptible species and increase root disease tolerant species would greatly reduce mortality and growth losses.